

ACOUSTIC TOMOGRAPHY WITH NAVY SONARS

John L. Spiesberger
Department of Meteorology
512 Walker Bldg.
University Park, PA 16802

phone: (814) 863-8601 fax: (814) 863-9527 email: jspies@ems.psu.edu
Award #: N00014-97-1-0484

LONG-TERM GOALS

The goal is to map the sound-speed and temperature fields of the oceans to increase the understanding of the ocean's circulation, the propagation of sound, and to increase surveillance capabilities. The maps are estimated using a Kalman filter based on data from acoustic tomography, hydrography, and satellites.

OBJECTIVES

Simulations with a validated ocean model show that the large-scale structures of the sound-speed and temperature fields may be accurately mapped with tomography when the navigational positions of the instruments have one-kilometer errors (Spiesberger *et al.*, 1997), when the transmission times of the sources have errors of minutes (Silivra *et al.*, 1997), and when the sources and receivers are mobile (Fabrikant *et al.*, 1998). We will show that it is possible to utilize passive and active Navy sonars to map the ocean.

APPROACH

We have obtained data from SOSUS, submarines, sonobuoys, and surface vessels. These data will be used to make tomographic maps of the sound speed and temperature fields.

Data from hydrographic surveys and satellites will be combined with the acoustic data using a Kalman filter. Interpretation of the temperature fields will be made with the aid of the outputs of the Naval Research Layered Ocean Model (Spiesberger *et al.*, 1998) in collaboration with Dr. Harley Hurlburt.

WORK COMPLETED

The U.S. Navy's data tapes from SOSUS stations can be processed to obtain signals from electronically generated sounds, such as those from ATOC's sources, and from other sounds from active Navy sonars.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 30 SEP 1997		2. REPORT TYPE		3. DATES COVERED 00-00-1997 to 00-00-1997	
4. TITLE AND SUBTITLE Acoustic Tomography with Navy Sonars				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Pennsylvania State University, Department of Meteorology, University Park, PA, 16802				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 3	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

RESULTS

We have shown that it is possible to read U.S. Navy data tapes at SOSUS stations to detect and coherently process a variety of acoustic signals.

IMPACT/APPLICATIONS

An accurate in-situ observing system will help fulfil the need for more data of the large scale temperature field at temporal scales less than a century or so. Since acoustic thermometry data can estimate the large scale temperature fields with more accuracy than satellite altimeters (Spiesberger *et al.*, 1998), much will be learned about the ocean by comparing these observing techniques. The in-situ observing systems will benefit surveillance systems.

TRANSITIONS

This project is in a demonstration phase and no transitions have occurred.

RELATED PROJECTS

The ATOC program is designed to transmit electronically generated acoustic signals to vertical arrays and SOSUS stations to detect global warming.

The GAMOT program is designed to use electronically generated acoustic signals to map and climatic temperature variability with mobile receivers. This later program uses the NRL Layered Ocean model to interpret their results. The NOPP program at APL/U. Washington, NRL-Stennis, NOAA PMEL, and NASA is designed to use vertical arrays and SOSUS stations to understand climatic temperature variability in the Pacific.

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